MOISTURE EXPANSION OF CONSTRUCTION CERAMICS DUE TO INCOMPLETE HIGH TEMPERATURE REACTIONS

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Moisture expansion of clay-based ceramics diminishes both the quality and the durability of the manufactured products due to critical changes on certain physical properties, such as: dimension, shape and intergranular cohesion of the ceramic bodies.

As a matter of fact, moisture expansion as an irreversible phenomenon is a real problem of paramount importance in the ceramic industry. It presently appears to be much more aggravated due to the non-compliance of clay paste composition and texture during the drying and firing processes which are becoming increasingly faster.

Moisture expansion causes negative economic consequences expressed on losses of both quality and durability of the ceramic products.

After drying and before firing moisture reabsorption diminishes the energy of the physical bonds that have been established between the mineral grains of the ceramic raw materials on the dried ceramic body. Moisture reabsorption promoting the formation of water films around mineral grains and the penetration of water into the intergranular pores, represents a reverse process compared to the one that promotes the approximation and establishment of good contacts between individual particles or particle aggregates due to the effect of drying.

After firing, moisture reabsorption and the subsequent expansion of the ceramic body takes place as well, however in a slower rate, and it is most certainly related either to mineral composition, or to the adopted firing cycle, or to both factors. In what mineral raw materials are concerned, moisture expansion, essentially and in theoretical terms, is the result of the reactivity with water and consequent rehydration of both cryptocrystalline metaphases and glass being produced during firing, due to: 1) incomplete transformation of minerals to stable crystalline phases; 2) glass formation derived, either from the structural breakdown of clay minerals, or from the partial fusion of certain components of the ceramic pastes.

In the firing process, moisture expansion, essentially and in theoretical terms, is controlled by the following factors: 1) short duration of the firing cycles; 2) short residence time of the ceramic bodies at the maximum firing temperature.

The firing temperatures of the studied facing bricks made from illitic and carbonate bearing clays were within the range 850–900°C. At these temperatures the evolution of structural water, in the form of (OH) from mica-illite was found to be incomplete, as it could be demonstrated by both differential thermal analysis (DTA) and X-ray diffraction (XRD) analysis. Also, the CaO formed from the decomposition of calcite did not fully reacted with SiO_2. In what concerns the assessment, in terms of quality decay due to moisture expansion, some relevant properties, such as, water reabsorption, and mechanical resistance to flexion and compression, were determined on ceramic test bodies, after drying and after firing.